SPECIAL SPECIFICATION

SECTION 15401S

PLUMBING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This specification, in conjunction with the design drawings and other contract documents, specifies materials and operations required for the installation of interior plumbing systems. Systems covered by this document are: domestic hot and cold water; sanitary waste, drain and vent; laboratory waste, drain and vent; roof drains; and indirect or special drains. Operations include the specification of piping, fittings, valves, joints, fixtures, equipment, tests, and disinfection.

B. Pipe and fittings to be used for modifications or additions shall be the same material (galvanized steel, copper, etc.) as the existing systems being modified, and shall conform to the following unless otherwise indicated on the applicable contract drawings.

1.02 QUALITY ASSURANCE

A. Welding Materials and Procedures: Shall conform to ASME code for Pressure Piping, ANSI/ASME B31.1, Power Piping.

B. Employ welders certified in accordance with ASME Boiler and Pressure Vessel Code, as modified by ANSI/ASME B31.1, Power Piping.

C. Brazing: Certify brazing procedures, brazers, and operators in accordance with ANSI/ASME B31.1, Power Piping, for shop and jobsite brazing of piping work.

D. Soldering: Conform to ANSI/ASME B31.1, Power Piping.

1.03 RELATED SECTIONS

The current editions of the following standards are to be considered a part of this specification. They are listed in the order of governance.

A. Sandia National Laboratories Standard Specifications

01300 Submittals

02200 Earthwork

09900 Painting

13085S Seismic Protection

15050S **Basic Mechanical Materials and Materials**

15200 Vibration Limits and Control

15083**S** **Pipe and Equipment Insulation**

B. American National Standards Institute (ANSI)

B1.1 Unified Inch Screw Threads

B1.2 Gages and Gaging for Unified Inch Screw Threads

B2.1 Standard Welding Procedures

B16.1 Cast Iron Pipe, Flanges and Flanged Fittings

B16.3 Malleable Iron Threaded Fittings Classes 150 and 300

B16.4 Cast Iron Threaded fittings Classes 125 and 250

B16.5 Pipe Flanges and Flanged Fittings

B16.9 Factory-made Wrought Steel Butt welding Fittings

B16.10 Face to Face and End to End Dimensions of Valves

B16.11 Forged Steel Fittings, Socket Welding and Threaded

B16.12 Cast Iron Threaded Drainage Fittings

B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

B16.23 Cast Copper Alloy Solder Joint Drainage Fittings

B16.24 Bronze Pipe, Flanges and Flanged Fittings (Class 150 and 300)

B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings

B16.34 Valves - Flanged, Threaded and Welding End

B31.1 Power Piping

Z358.1 Emergency Shower and Eyewash Equipment

C. American Society for Testing and Materials (ASTM)

A53 Standard Specification for Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless

A74 Standard Specification for Cast Iron Soil Pipe and Fittings

A307 Standard Specification for Steel Bolts and Studs, 60,000 psi Tensile Strength

A518 Standard Specification for Corrosion Resistant High Silicon Iron Castings

B88 Standard Specification for Copper Water Tube

D1785 Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 & 120

D2447 Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40 and 80

D2466 Standard Specification for Poly Vinyl Chloride Socket-Type Plastic Pipe Fittings (Schedule 40)

D2464 Poly Vinyl Chloride (PVC) Threaded Plastic Pipe Fittings, Schedule 80

D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

D2467 Standard Specification for Poly Vinyl Chloride Socket Type Plastic Pipe and Fittings, Schedule 80

D2774 Standard Recommended Practice for Installation of Thermoplastic Pressure Piping

D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

D3222 Standard Specification for Unmodified PVDF Molding Extrusion and Coating Materials

D4101 Standard Specification for Propylene Plastic Injection and Extrusion Materials

D. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes

E. American Waterworks Association (AWWA): C651 Disinfecting Water Mains

F. American Welding Society (AWS): A5.8 Specification for Brazing Filler Metal

G. Federal Specification (FS) Published by the Federal Specification Board: WW-P-401 Cast Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems

H. Cast Iron Soil Pipe Institute (CISPI)

301 Cast Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems

I. Underwriters Laboratories, Inc. (UL)

J. International Association of Mechanical and Plumbing Officials (IAMPO); Conference of Building Officials (ICBO): Uniform Plumbing Code (UPC)

K. National Fire Protection Association (NFPA) Code 70

L. National Electric Codes (NEC)

Article 110-16

Article 250-80

Article 384-4

M. American Gas Association (AGA)

Z21.8 Installation of Domestic Gas Conversion Burners

Z1.10.1 Gas Water Heaters Volume III Storage, with Input Ratings Above 75,00 BTU Per Hour, Circulating and Instantaneous Water Heaters

Z21.71 Automatic Intermitent Pilot Ignition Systems for Field Installation

1.04 SUBMITTALS

A. Where specific manufacturer or model numbers are mentioned in these specifications, proposed substitutions shall be included in the submittal package furnished to the Sandia Delegated Representative (SDR) for approval before contract award.

B. Submittals shall be as per Standard Specification, Section 01300.

C. Pipe materials, valves, equipment, and accessories not listed in this specification under **PART - 2 - PRODUCTS** shall be submitted for approval.

D. Relief valves require submittals for approval.

E. Backflow preventers require submittals for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

The firms listed in Section 2.02, Plumbing Materials, meet the function, quality, and performance requirements.

2.02 PLUMBING MATERIALS

A. Potable Piping:

1. Plumbing for potable systems shall be lead-free per Public Law 99-339, Safe Water Act.

2. Lead-free is defined as no more than 0.2 percent lead in solder and solder flux, and no more than 8 percent lead in pipe and fittings.

B. Domestic Hot and Cold Water, Non-Potable Water, and Pressure Drain Piping:

1. Above Grade: Piping shall be Schedule 40, galvanized steel pipe, ASTM A53, Grade A or B, with 150 pound galvanized malleable iron screwed fittings conforming to

ANSI B16.3 or Type L hard drawn copper tubing, ASTM B88, with wrought copper solder type fittings conforming to ANSI B16.22. Screwed joints in piping are restricted to pipe sizes 2" and smaller.

2. Below Grade: Type K copper tubing shall be used. Fittings shall be flared solder type of brass, bronze or wrought copper.

C. Soil, Waste, and Gravity Drain Piping: Cast iron soil pipe, fittings and connections shall comply with CISPI guidelines.

1. Below Grade: Piping shall be service weight hub and spigot (with gasket) coated cast iron and shall conform to ASTM A74.

2. Above Grade: Piping shall be Schedule 40, galvanized steel pipe, ASTM A53, with threaded, galvanized cast iron drainage fittings, ANSI B16.12; or DWV copper pipe with solder joint DWV wrought copper fittings; or service weight hub-spigot (with gasket) coated cast iron pipe and fittings conforming to ASTM A74; or hubless cast iron pipe and fittings conforming to Federal Specification WW-P-401.

D. Vent Piping: Piping shall be Schedule 40 galvanized steel pipe, ASTM A53, with galvanized cast iron or malleable iron screwed fittings conforming to ANSI B16.12; or DWV copper pipe with DWV wrought copper fittings; or service weight hub-spigot (with gasket) coated cast iron pipe and fittings conforming to ASTM A74; or hubless cast iron pipe and fittings conforming to Federal Specification WW-P-401. .

F. Roof Drain Leaders:

1. Below Grade: Leaders shall be service weight hub and spigot coated cast iron and shall conform to ASTM A74.

2. Above Grade: Schedule 40 galvanized steel pipe, ASTM A53, with galvanized cast iron screwed drainage fittings, ANSI B16.12; or wrought copper DWV with solder joint DWV fittings; or service weight hub-spigot coated cast iron pipe and fittings conforming to ASTM A74; or hubless cast iron pipe and fittings conforming to Federal Specification WW-P-401.

G. PVC Piping: Where PVC piping is specified on the drawings, the following materials and procedures shall be used. PVC pipe shall only be used where specified on the drawings.

1. Drain, Waste, and Vent Piping: Drain, waste, and vent piping and fittings shall be in compliance with ASTM D2665.

2. Pressure Rated Piping: Pressure rated piping material shall comply with ASTM D1785, Schedule 40. Use socket fittings with solvent cemented joints complying with ASTM D2466 and ASTM 2467. Threaded PVC pipe shall be Schedule 80 minimum wall thickness and fittings shall comply with ASTM 2464.

H. Equipment Drains And Indirect Waste: Piping shall be Schedule 40 galvanized steel pipe, ASTM A53, with galvanized cast iron screwed drainage fittings conforming to ANSI B16.12 or DWV copper pipe with DWV wrought copper fittings in compliance with ANSI B16.29.

2.03 VALVES

A. NO SOLDERED VALVES PERMITTED.
VALVES MUST BE CERTIFIED ASBESTOS FREE.

B. Gate: Class 125

1. Screwed: Bronze, bronze trim, rising stem inside thread union bonnet. Crane No. 430 UB.

2. Flanged: OS&Y iron body, bronze trim, rising stem, Crane No. 465-1/2.

C. Ball: 125 psi SWP, 400 psi W.O.G.

1. Screwed: 2 piece bronze body, blow-out proof captive stainless steel stem, teflon seals and seats, full ported 316 stainless steel ball. Nibco T-585-66.

2. Flanged: Class 150, iron body, blow-proof captive stainless steel stem and ball, double teflon seals and seats. Worcester Series 51.

D. Globe: Class 125

1. Screwed: Bronze, inside screw, union bonnet, regrinding beveled disc; Jenkins Fig. 750.

2. Flanged: Iron, OS&Y, bronze trim, bronze disc, backseated, Crane No. 143.

E. Butterfly: Class 200

1. Flanged: Sizes 2" to 36"; full bolt pattern, iron body, aluminum/bronze disc, stainless steel shaft, Buna N seals, lug type for dead end service, gear operator for greater than 4 inch size and lever operator for 4 inches and smaller. Norris Model R3010-43-2K.

2. Threaded: Sizes 1 1/2" to 2 1/2"; High tensile strength cast iron body,ASTM A126 Class B Cadmium plated, with aluminum bronze disc, 416 SS shaft, and Hycar O-ring. Norris Model M0110-431-A.

3. Wafer: Not permitted.

F. Check, Swing:

1. Screwed: Class 125, bronze, Y pattern, screw cap. Crane No. 37.

2. Flanged: Class 150, steel, renewable seats, flanged cap. Powell 1561A.

G. Check, Vertical:

Screwed: Class 125, bronze, spring actuated, inline lift type, TFE seat ring. Nibco T-480-Y.

2.04 STRAINERS, FLANGES AND UNIONS

A. Strainers:

1. Screwed: Iron, screwed bronze cap, 20 mesh monel screen for water service. Crane No. 988-1/2.

2. Screwed: Bronze, screwed bronze cap, 20 mesh stainless steel screen for water service. Spirax/Sarco Type BT.

3. Flanged: Iron, bolted iron cap, 20 mesh monel screen for water service. Crane No. 989-1/2.

B. Flanges:

1. 1-1/2 Inches and Smaller: Class 150, forged steel, screwed, ANSI B16.5.

2. 2 Inches and Larger: Class 150, forged steel welding neck, ANSI B16.5.

3. Copper Systems: Class 150, Cast Copper, ANSI B16.23.

C. Unions:

Piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings prescribed with which they are used. Union pressure classes and end connections shall be the same as the fittings used in the lines with the unions.

1. Steel unions shall have hardened stainless steel seating surfaces on both faces.

2. Dielectric unions shall be used to join two dissimilar materials (ferrous and non-ferrous metallic.)

2.05 CLEANOUTS

Cleanouts shall have an iron body with heavy brass plugs, except on acid resistant cleanouts.

A. Floor Cleanout: Shall be Zurn Z-1400 or Z-1405 (Normal Traffic)
Shall be Zurn Z-1420-25 or Z-1425-25 (Heavy Traffic)

B. Wall Cleanouts: Shall be Zurn Z-1440 or 1445.

C. Acid Resistant Cleanouts: Cleanouts for acid resistant waste lines shall be of the same material as the connecting waste pipes or approved equal.

2.06 PLUMBING FIXTURES

Ordinary plumbing fixtures are specified here. Refer to the contract drawings for laboratory and special equipment. Fixtures shall be white and furnished with all trim and accessories required for a complete installation. Fixtures shall be provided with stop valves on both hot and cold water supplies. Metal trimmings on fixtures and exposed piping to fixtures, unless otherwise noted, shall be chromium plated with chromium plated escutcheons. Toilets and lavatories shall

be mounted on Sandia Delegated Representative (SDR) approved carriers or as indicated on the drawings.

A. Toilets

1. Floor Mounted, Tank Type: American Standard elongated "Cadet", 2109.416 (18" high) or 2109.405 (14" high) elongated bowl, water saver, siphon jet closet, Olsonite #95 open front seat.

2. Floor Mounted, Flush Valve Type: American Standard "Madera", No. 2221.018, water saver, siphon jet closet, elongated bowl with Sloan Royal 110FYV flush valve and Olsonite #95 white open front seat.

3. Wall hung, Flush Valve Type: American Standard "Afwall", No. 2477.024, water saver, top spud, siphon jet closet, elongated bowl with Sloan Royal 11**1** flush valve, Olsonite #95 white open-front seat.

B. Urinal:

American Standard "Washbrook", No. 6500.010, wall-hung with Sloan Royal 186 1.**0** gpm flush valve and approved wall hanger.

C. Lavatories & Faucets:

1. Kohler "Farmington", No. K2900, in-counter mount with wire rim, white enamelled cast iron oval bowl, 4 in. faucet centers.

2. Kohler "Hudson", No. K2861, wall-mount, white enamelled cast iron bowl, 4 in. faucet centers.

3. Faucet: Bradley, No. 90-75, 4 inch centers, barrier free,metering.

D. Service Sink:

1. Crane, No. 7-563, Wall-mounted, 24 inch x 20 inch, acid resistant, enameled cast iron bowl with stainless rim guard, R-8758 mixing faucet, and cast iron trap standard with brass cleanout plug and strainer.

2. Kohler, No. K-6710, Floor-mounted, white enamelled cast iron, with wire rim guard, chrome faucet with lever handles, vacuum breaker, rubber hose and wall hook, with No. K9146 perforated strainer.

E. Wall Hydrant:

Wade No. W-860**0**, freeze-proof, ¾" hose connection, with vacuum breaker, polished brass with fixed key.

F. Drinking Fountains, Electric:

New drinking fountains shall be barrier-free. Haws Model No. H**1011.8H0**. Dual Fountain heights, heavy gauge stainless steel construction with No. 4 satin finish, provided with 3 wire grounding type cord and plug, UL listed.

G. Emergency Shower and Eyewash:

1. Inside: emergency showers and eyewash stations are to be barrier-free. Bradley, Model No. S19-310BF, stainless steel bowl and Face Spray Ring. Provisions for vertical or horizontal supply. Shower valve to be 1" IPS stay-open ball valve. Eyewash valve to be 3/4" IPS stay open hand operated ball valve. Units shall meet ANSI Z358.1.

2. Outside: emergency showers and eyewash stations are to be frostproof. Bradley Model No. S19-310HFP, stainless steel bowl and face spray ring. Provisions for vertical or horizontal supply. Shower valve to be 1" IPS stay-open ball valve. Eyewash valve to be 3/4" IPS stay open hand operated ball valve. Units shall meet ANSI Z358.1.

2.07 EQUIPMENT

Equipment required for installation on this contract shall be as specified and as shown on the applicable contract drawings and shall be furnished complete with accessories normally supplied with the catalog item listed and other accessories necessary for a complete and satisfactory operating system.

A. Domestic Water Heaters:

1. Domestic water heaters shall be stock catalog item of standard manufacturer, glass lined, and unconditionally guaranteed for a minimum of 10 years. Insulation shall be fiberglass with minimum R-value of 5. Tank shall be nameplate rated for 127.5 psig (minimum working pressure) and shall be constructed, certified and stamped to meet ASME Boiler and Pressure Vessel Code.

2. Two copies of the manufacturer's Data Sheets shall be submitted to the SDR for approval and record keeping.

3. Dip tubes, hot and cold water supply nipples, and baffles or heat traps used in the tank shall be made to withstand a temperature of 400^{o}F without deteriorating in any manner.

4. Gas burners shall be of the high recovery type and AGA and UL listed. Electric water heaters shall be UL listed.

5. Water heaters shall be provided with ASME Boiler and Pressure Vessel Code certified and stamped combination temperature and pressure relief valves with test lever.

B. Hot Water Storage Tanks:

1. Tanks shall be constructed, certified and stamped to meet ASME Boiler and Pressure Vessel Code. Tanks shall be glass lined, and provided with a thermometer and thermometer well installed at the points where the water enters and leaves the tank.

2. Tanks 80 gallons and larger shall have a 12" x 16" manhole.

3. Tanks, regardless of size, shall be provided with an ASME combination temperature and pressure relief valve with test lever.

4. Two copies of the manufacturer's Data Sheets shall be submitted to the SDR for approval and record keeping.

C. Temperature and Pressure Relief Valves:

1. All temperature and pressure relief valves shall be in compliance with UPC.

2. Relief valves shall be factory set; ASME listed, certified, and stamped.

3. Relief valves shall be sized to relieve the unregulated capacity of the Pressure Regulating Valve (PRV), burner, or heating element.

PART 3 - EXECUTION

3.01 PLUMBING INSTALLATION

A. Contamination Prevention:

1. Pipe interiors shall be kept free of debris.

2. Interior surfaces of potable water pipes, valves and fittings shall be protected against contamination, as well as debris. All openings in pipelines shall be closed with watertight plugs when work is halted on the system. Sealing and packing materials shall not support the growth of bacteria. Trenches that become wet shall be treated with calcium hypochlorite granules to prevent bacterial growth.

B. General:

1. Plumbing accommodations in government facilities shall conform to 28 CFR Part 36, Nondiscrimination on the Basis of Disability by Public Accommodations in Commercial Facilities.

2. Plumbing installation shall be coordinated with respect to space available for heating, ventilating, and electrical installation. In case of conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows; shall not encroach on aisles, passageways, and equipment; and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Pipe shall not be bent. Cutting or weakening of structural members to facilitate piping installation is not permitted.

3. Plumbing installation shall maintain the working spaces around electrical equipment as required by NEC articles 110-116, 250-80 and 384-4, and SNL Electrical Safety Bulletin Vol. 1,2,3 and 4. Replacement of existing metal water piping shall not occur without first ascertaining how the electrical ground system is configured.

4. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1" in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings. Service pipe, valves, and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2" from such other work, and not less than 1/2" between finished covering on the different services.

C. Reducers: Reduction in pipe sizes shall be made with one-piece reducing fittings. Forged bushings reducing at least two pipe sizes will be ACCEPTABLE ONLY when there is no room for manufactured reducing couplings or swaged nipples. Cast bushings ARE NOT acceptable.

D. Unions: Unions shall be installed at all equipment, instruments, and down stream of valves.

E. Installation of Valves: DO NOT SOLDER VALVES IN PLACE. Valves shall be installed at the locations shown on the drawings and where specified. Gate valves shall be used unless otherwise shown, specified, or directed by the Sandia Delegated Representative (SDR). All valves shall be installed with their stems between the horizontal the the 90 degree vertical. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used. Provide access to all concealed valves by means of access doors furnished and installed by the Contractor.

F. Hangers and Supports:

1. Piping, unless otherwise directed by governing documents or the SDR, shall be rigidly supported from the building structure by means of adjustable ring-type hangers. (WELDING TO BUILDING STRUCTURE WILL NOT BE PERMITTED.) Where pipes run side by side, support on rod and angle iron or Unistrut trapeze hangers. Hanger spacing shall be as follows:

Steel Piping	Maximum Spacing
3/8" and under	4'-0"
1/2" through 1"	7'-0"
1-1/4" through 4"	10'-0"
5" through 8"	16'-0"
10" and larger	20'-0"

Copper Piping	Maximum Spacing
3/8" and under	4'-0"
1/2" through 3/4"	6'-0"
1" through 1-1/2"	8'-0"
2" and larger	10'-0"

Plastic Piping	Maximum Spacing
All sizes	4'-0"

Cast Iron Piping	Maximum Spacing
5' lengths	5'-0"
10' lengths	10'-0"
Hubless	At every joint

2. Round rods supporting the pipe hangers shall be of the following dimensions:

3/8" to 2" pipe	3/8" rod
2-1/2" to 3" pipe	1/2" rod
4" to 5" pipe	5/8" rod
6" pipe	3/4" rod
8" through 12"	7/8" rod
14" through 16"	1" rod

3. Rods for trapeze hangers shall be a minimum of 3/8" and shall have the equivalent cross section listed above per pipe supported. The use of pipe hooks, chains, perforated iron strapping or wire for pipe supports WILL NOT be permitted.

4. Hanger rods shall be galvanized carbon steel per ASTM A307, Grade B, threaded per ANSI B1.1 coarse thread series, Class 2A fit. Hanger rods shall have minimum 6" threaded ends. Double nut all hangers or use a safety tab.

5. Place a hanger within 1'-0" on both sides of each horizontal elbow.

6. Hanger rods shall be installed vertically. No offset in hanger rods will be permitted.

7. Use hangers which are vertically adjustable 1-1/2" minimum after piping is erected.

8. Use copper straps on copper pipe and ferrous hangers on ferrous pipe.

9. Soft copper tubing, where permitted, shall be fastened to the building structure with Unistrut-type copper pipe clamps and spaced not more than 4'-0" apart.

10. Fasten vertical pipes to rigid structural members at each floor or at 10'-0" maximum spacing, unless otherwise directed.

11. On 4" and larger piping, install hangers adjacent to (within 1'-0" on each side) all strainers, check valves, valves, and all flanged items.

12. "C" clamp style hanger shall only be installed with retaining clip.

13. Insulated pipes shall be protected using galvanized steel shield similar to Grinnel Figure 167 or 360^{o} galvanized steel shield by Pipe Shields Inc. or an SDR approved equal.

G. Joints:

1. Cast iron pipe joints shall be made in accordance with the Uniform Plumbing Code, Section 802.

   a. Caulked joints for bell and spigot water pipe shall be made with non-toxic materials in accordance with UPC, 802(a).

   b. Compression joints for bell and spigot pipe shall have flexible, compression factory-fabricated joints composed of a neoprene gasketing system in accordance with UPC, 802(k).

   c. Hubless joints shall conform to standard specification 301 of the Cast Iron Soil Pipe Institute, and Federal Specification WW-P-401 in above ground systems.

2. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be machined flush. All flange bolt holes shall straddle the horizontal and vertical centerlines unless otherwise noted. Bolting shall comply with ANSI/ASME B31.1, Power Piping.

   a. Install insulating kits on flanges connecting dissimilar metals (such as steel to copper) to prevent electrolytic action.

   b. The following procedure shall be followed when making final assembly of a bolted flange joint.

      1. Place the gasket on the gasket seating surface and bring the cover flange in contact with the gasket. Do not glue the gasket in place.

      2. Install all bolts, making sure they are free of dirt and grit, and are well lubricated.

      3. Run-up all nuts finger tight.

      4. Develop the required bolt stress in a minimum of four steps: (1) stress the bolts to about 30% of their required stresses, tightening one bolt after another in a clockwise motion, (2) stress to about 60%, tightening each bolt one after the other in a clockwise manner, (3) tighten to about 90%, and (4) perform final tightening, again in a clockwise manner.

3. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads, ANSI B1.2. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. The joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

4. Brazed/Soldered Joints:

   a. Cut tube ends square. Ream, remove burrs, and size.

   b. All joints in piping systems with pressure above 100 psig or service temperature above 200 °F shall be brazed.

   c. Brazed copper to copper joints shall be made with a silver brazing alloy conforming to AWS A5.8, BCuP-5 (15% silver). Joints shall comply with ANSI/ASME B31.1 Power Piping.

   d. Brazed copper to brass, or copper to stainless steel joints shall be made with a silver brazing alloy conforming to AWS A5.8, BAg-7 (45% silver). Joints shall comply with ANSI/ASME B31.1 Power Piping.

   e. All solder joints, for copper tubing, shall be made with 95-5 tin-antimony solder with the following exception:

      Solder containing antimony SHALL NOT be used to join metals containing zinc (e.g., galvanized iron, galvanized steel, and brass).

   f. Use sand cloth or a steel wire brush to clean surfaces to be joined. Steel wool IS NOT permitted.

H. Cross-Connection Control:

1. A backflow prevention assembly (BFP) shall be installed to prevent cross-connection contamination between potable water systems and non-potable or potentially polluted, or contaminated systems, such as a drainage systems, soil lines, fire protection lines or chemical lines.

2. All potable water fixture outlets with hose attachments, such as hose bibbs, yard hydrants, janitor sinks and lab sinks, shall be protected by an approved (SDR or IAMPO) vacuum breaker device.

3. Backflow prevention (BFP) assemblies shall be approved by the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (USC-FCCCHR) and IAPMO.

4. Backflow prevention assemblies used or installed under this contract shall be tested by a "Certified Backflow Control Assembly Tester" who possesses a current (within three (3) years from date of issuance) certificate that confirms successful completion of an approved (SDR specified or USC-FCCCHR or Colorado Environmental Training Center, Golden, Colorado) training course.

5. The Contractor shall perform an operational test on any new or relocated backflow prevention assemblies used or installed under this contract. Passing backflow

preventers shall be labelled with a tag indicating: test performed, tester's initials and date. Testing documentation shall be submitted to the Sandia Delegated Representative (SDR).

6. Repairs to BFPs shall be made with original manufacturer's parts.

7. Piping downstream of BFPs shall be labelled non-potable or NPW in accordance with SNL Specification 15050.

I. Drains:

1. Drains indicated on the drawings in connection with water distribution systems shall be 1/2" bronze valves (gate) with bronze caps or plugs, unless otherwise noted.

2. Additional drains shall be installed at low points on the hot water and cold water piping to ensure proper draining of the system, and all piping shall pitch to the drains. Hose bibbs (3/4"), with integral vacuum breaker, shall be provided as drain valves at low points.

J. Equipment Connections:

1. All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment.

2. The Contractor shall be required as directed by the Sandia Delegated Representative (SDR), to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected.

3. Pipe connections to equipment shall be made with unions, flex connectors, flanged fittings or grooved couplings.

4. Eccentric reducers are required at pumps and other equipment for air removal.

5. Install water heaters per AGA Z21.8, Z21.10.1 and Z21.71.

K. Air Chambers (Shock Absorbers): Sizes and locations of shock absorbers shall be as indicated on the drawings and shall be installed in an easily accessible location.

L. Dielectric unions shall be used to connect dissimilar metals (such as steel to copper) to prevent electrolytic action.

M. Insulation of all pipes, valves, fittings, and equipment shall be in accordance with Standard Specification, Section 15250, unless noted otherwise on the drawings.

N. Identification and Labels: All plumbing systems shall be labeled and identified in accordance with Standard Specification, Section 15050.

O. Chlorine Injection Port: A 3-way ball valve or an SDR approved cleanout port shall be installed on the new line directly off of the existing main to aide in the sterilization tests of new water lines.

P. Relief valves:

1. Discharge from relief valves located inside buildings shall be piped full size and extended to the outside of the building. Potable water lines shall either be turned down towards the ground and terminated between 6" and 2 feet above the ground, or be piped to a drain. Potentially contaminated lines must be directed via pipelines to a closed drain. Piping shall be sloped 1/8" per foot.

2. No valves of any type shall be placed between the relief valve and the equipment to be protected.

Q. Escutcheons shall be provided at wall, ceiling and floor penetrations of piping in occupied areas.

R. Access doors shall be provided where maintenance access is required (at shut-off valves, BFPs, etc.)

3.02 SOIL, WASTE, AND VENT PIPING INSTALLATION

A. General: Soil, waste, and vent piping systems shall be complete as indicated on the drawings with connections to all equipment requiring waste connections. Horizontal drain and waste pipes shall be given a grade of 1/4" per foot where possible, but in no case less than 1/8" per foot. Horizontal vent pipes shall be pitched up to the vent stacks without forming traps in pipes. Vertical vent pipes may be connected into one main vent riser not less than 18" above vented fixtures. Where an end or circuit vent pipe from any fixture or line of fixtures is connected to a vent line serving other fixtures, the connection shall be 4'-0" minimum above the floor on which the fixtures are located, to prevent the use of any vent line as a waste. All excavation and backfill shall be in accordance with Standard Specification, Section 02200.

B. Fittings: All changes in pipe size on waste and drain lines shall be made with reducing fittings. All changes in direction require a cleanout and shall be made by the appropriate use of wyes, half wyes, and long sweep bends, except that sanitary tees may be used on vertical stacks, and short quarter bends or elbows may be used in waste lines where the change in direction of flow is from the horizontal to the vertical. Where it becomes necessary because of space conditions to use short radius fittings in any other locations, an approval SHALL BE obtained before they are installed.

C. Cleanouts: Cleanouts shall be of the same size as the pipe, except that cleanout plugs larger than 4" WILL NOT be required. Cleanouts installed in connection with cast iron soil pipe shall consist of a long sweep quarter bend or one or two eighth bends extended to an easily accessible location, or as indicated on the drawings. Where cleanouts in connection with threaded pipe are shown and are accessible, they shall be cast iron drainage T-pattern, 90 degree branch fittings with square head brass screw plugs of the same size as the pipe, up to and including 4".

D. Vent Pipes: Vent pipes less than 2" in size shall be increased to 2" before extending through roof to prevent frost closure. Vent pipes 2" and larger shall extend through roof full size. Vents shall extend at least 6 inches above the roof and 6 inches from any vertical surface. Each vent shall terminate not less than 10 feet from or at least 3 feet above any window, door, opening, air intake, or vent shaft. Vent pipes shall be flashed and made water-tight at the roof in accordance with the architectural standards.

E. Prohibited Fittings And Connections: No lead flashing, running threads, bands or saddles shall be used in the drainage system. No drainage or vent piping shall be drilled, tapped, welded, or brazed. Heel or side-inlet quarter bends shall not be used when the inlet is placed in a horizontal position as a vent. Any fitting or connection that offers abnormal obstruction to flow through a drain is prohibited. No long screws or bushings shall be used. No street elbows.

3.03 PVC PIPING INSTALLATION

Where PVC is prescribed, install per ASTM D2774. The following procedure shall be used when installing PVC pipe.

A. Joints, Threaded Connection: Threading of PVC pipe is permitted on Schedule 80 or heavier.

B. Supports: Support at end of branches and at changes of direction or elevation. Follow manufacturer's recommendations for clamping procedures, to control thermal expansion.

C. Exposed Piping: PVC piping, with the exception of vents, shall not be exposed to UV radiation (sunlight), per UPC 315.3. Exposed vents shall be protected by a water-based synthetic paint.

3.04 POLYPROPYLENE (FUSEAL) PIPING INSTALLATION

A. General: Fusion and mechanical joints shall be installed by experienced pipe fitters and as per the manufacturer's instructions. The Contractor shall provide all tools and equipment necessary for proper installation.

B. Horizontal Piping: Support horizontal piping at end of branches, and at change of direction or elevation. Clamp piping where shown to control thermal expansion, per manufacturer's recommendations.

C. Vertical Piping: Support risers with standard riser clamp or wall brackets.

D. Mechanical Joints: Circumferential grooves in the pipe shall not exceed 0.030 inches depth when mechanical joints are used.

3.05 FIXTURE AND EQUIPMENT INSTALLATION

A. General: All fixtures and equipment shall be installed complete with all accessories and trim required for proper installation.

B. Temporary Strainers: or "start-up" socks shall be installed at each new strainer and at each pump inlet, and allowed to remain in place for the first 24 hours of equipment operation.

C. Fixtures: Fixtures shall be firmly bolted to wall, floors, or carriers in accordance with the manufacturer's roughing-in and setting requirements and drawings. Proper provision for hanging and setting fixtures and accessories shall be made by the Contractor during building construction. Where "rough-in only" is specified, rough-in shall include stop valves on all service lines and waste line shall be capped, ready for installation of trap by others. All fixtures shall be installed square with the wall, in line, and level to provide a workmanlike and uniform appearance.

D. Equipment: Equipment shall be installed in accordance with the manufacturer's directions and shall be supported and fastened in a satisfactory manner. Piping connections to the equipment shall be made with union or flanged connections for easy removal and shall be installed without strain at the pipe connection to the equipment. The Contractor may be directed to disconnect the unions or remove the flanges to demonstrate unstrained alignment.

E. Traps: Each fixture and piece of equipment connecting to the drainage system shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double-trapped.

3.06 TESTS

A. General: All plumbing, piping, equipment, and fixtures installed under this contract shall be inspected and tested before insulation is installed, by the Contractor in the presence of the Sandia Delegated Representative (SDR), and approved before acceptance. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying the tests. Prior to performing hydrostatic tests, (see below), all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water at a sufficient flow rate and period to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory cleaning and flushing of the lines shall be subject to approval by the SDR.

B. Water System: Upon completion of the roughing-in and before setting fixtures, the entire hot and cold water piping systems installed under this contract shall be hydrostatically tested at a pressure of not less than 125 psig for 2 hours and proved tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be hydrostatically tested separately in the same manner as prescribed for the entire system.

C. Sanitary System: The sanitary soil, waste and vent piping installed under this contract shall be tested by plugging all outlets and filling the lines with water to the level of the highest vent stack above the roof. The system shall hold this water for one hour without showing

a drop greater than 3". Where only a segment of the system is to be tested, the test shall be conducted in the same manner as prescribed for the entire system, except that a vertical stack 10 feet (or height as recommended by the UPC) above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. Suitable fittings, such as plugged tees, shall be installed by the Contractor if needed to isolate portions of the system for testing purposes. The pressure shall be maintained for one hour. All joints shall be inspected for visible leaks. All soil or waste piping located underground shall be tested before backfilling.

D. Final Plumbing Fixture Test: Upon installation of the plumbing fixtures, appurtenances or appliances having water and/or waste connections, and prior to the general use thereof, all water and waste connections shall have been proved tight, without defects or leaks by such operating tests as directed by the SDR.

3.07 DISINFECTION

Piping installed under this contract shall be disinfected per AWWA C651 before it is placed in operation. Follow one of two methods from AWWA C651, section 5.2.

A. Continuous Feed Method:

1. Place calcium hypochlorite in pipe sections when installing pipe or inject liquid chlorine into the system via the injection port. Pipe is filled with water and chlorine concentration shall remain at 10 mg/l for a minimum of 24 hours. During this time, all valves in new section will be cycled open and closed to allow for adequate disinfection. Valves connecting the new or repaired line with mains in active service shall remain closed to prevent chlorine pollution.

2. Samples shall be drawn at 1, 4, 8, 12, 16, 20, and 24 hour marks to determine the chlorine concentration. Acceptable tests are the DPD drop dilution method (AWWA C651, Appendix A) or the High Range Test Kit. The tests shall be done by the contractor or other SDR designee and witnessed by the SDR. The results shall be recorded for auditing purposes.

B. Slug Method:

1. Similar to the continuous feed method. Follow AWWA C651 section 5.3. Chlorine concentration to be 100 mg/l for a minimum of 3 hours. During this time, all valves shall be cycled open and closed to allow for adequate disinfection. Valves connecting new or repaired lines with mains in active service shall remain closed to prevent chlorine pollution.

2. Samples shall be drawn every 15 minutes to determine concentration. Acceptable tests are the DPD drop dilution method or the High Range Test Kit. The tests shall be conducted by the contractor or SDR designee and witnessed by the SDR. The results shall be recorded for auditing purposes.

C. Repairing or Cutting into Existing Mains:

1. New interior piping surfaces shall be swabbed with a 1% hypochlorite solution. The section being modified shall be subjected to a high chlorine disinfection process per AWWA C651, section 9. The concentration shall be a minimum of 300 mg/l for 15 minutes.

2. Samples shall be drawn before the chlorine is injected and every 5 minutes thereafter. Chlorine concentration shall be tested by the contractor or SDR designee using the High Range Test Kit. SDR shall witness the test and results shall be recorded.

D. Flushing:

1. After the lines have been chlorinated using one of the above methods, it becomes necessary to flush the lines with water until test sample indicates that the water is suitable for drinking. The residual chlorine concentration in the water is to be between 0.2 and 2.0 mg/l, as measured using a Low Range Test Kit. The test shall be witnessed by SDR or other SDR designee and the results recorded.

2. Heavily contaminated water shall be disposed of or neutralized under the direction of SNL Pollution Prevention and Environmental Monitoring Department, 7725.

E. Bacteriological Testing:

1. All new and modified water lines require testing for coliform organisms per AWWA C651, sections 7 and 9.5. The testing shall occur after successful chlorination and flushing of the lines. Samples shall be taken from the new line in sodium thiosulfate treated sterile bottles and analyzed as specified by Standard Methods for the Examination of Water and Wastewater. Analysis, at the discretion of the SDR representative shall be performed by SNL Industrial Hygiene or an independent laboratory.

2. Results shall be recorded with the original documentation of results attached. These will be used for auditing purposes.

3. Water lines **WILL NOT** be accepted until a negative bacteriological test is performed. Lines will be chlorinated and flushed repeatedly, at no additional cost to SNL, until such a negative test is accomplished.

F. In order to minimize water service downtime; distribution lines that have been wholly or partially dewatered, hydrostatically tested, treated with chlorine, and sampled for bacteria, may be returned to service prior to the results of the bacteriological testing.

END OF SECTION